
AN UPDATE ON
WORLD SUGAR SUPPLY AND DEMAND
1980 AND 1985

**UNITED STATES
DEPARTMENT OF
AGRICULTURE**

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FOREWORD

This publication is a supplement to "Report on World Sugar Supply and Demand - 1980 and 1985". The historical data base for supply and demand has been expanded to include 1974/75 and 1975/76, thereby giving a broader base for analysis. The present report, known as "Report on World Sugar Supply and Demand - 1980 and 1985 - An Update" had 2 more years of data in addition to the 20 years utilized in the first report.

Sugar is a very volatile commodity. It is produced almost worldwide, and is highly regulated in many of the producing and consuming countries. Therefore, future supply and demand may be influenced significantly by government or intergovernmental programs, as well as the usual factors, such as weather and prices. The projections in this "Update" did not attempt to predict the influence of any such programs.

This "Update" was done by the Development and Resources Corporation of Sacramento, California for the U.S. Department of Agriculture. Leslie C. Hurt, Sugar and Tropical Products Division, Foreign Agricultural Service, USDA, served as Project Leader for the study.

Use of commercial and trade names does not imply approval or constitute endorsement by USDA or the Foreign Agricultural Service.

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CONTENTS

	<u>Page</u>
INTRODUCTION	1
PROJECTION RESULTS	2
SUMMARY AND CONCLUSIONS	17
PHASE II ERRATA	28

INTRODUCTION

The world sugar market from 1954/55 to 1972/73 was relatively static with very few unexpected changes in supply or demand.¹ In late 1973 and 1974, the sugar supply and demand situation went through some rapid gyrations. World sugar prices increased six times over a 10- to 12-month period. There was speculative buying, the sugar market was thrown into disequilibrium, and the future of the world sugar market was uncertain. This period was followed by a period of excess supply from 1975 to the present (1978), when prices fell below production costs in some countries and sugar went begging for a market. The Foreign Agricultural Service of the U.S. Department of Agriculture set out to investigate the world sugar situation in detail beginning in 1974 and culminating with this report. FAS was assisted by Development and Resources Corporation, an international consulting company headed by David E. Lilienthal.

The investigation was conducted in two separate phases. Phase I focused on the collection, electronic data processing, verification, and documentation of consistent data series related to production and consumption of sugar in foreign countries. The data were published in October 1976 in Statistical Bulletin No. 562, entitled "Sugar: World Supply and Distribution, 1954/55-1973/74."

Phase II used the data generated in Phase I to project future prospects for foreign supply and demand in 1980 and 1985. Twenty-one major countries and six country groups such as OPEC were analyzed in detail. These countries and country groups account for a majority of the world's consumption, production, and trade. Countries not analyzed individually or included among the country groups were aggregated into a "Rest of the World" category so that the total world supply and demand situation could be examined.² The results of this investigation were published in a November 1977 report entitled "Report on World Sugar Supply and Demand, 1980 and 1985."

¹Sugar as defined in this study includes all centrifugal sugar.

²The U.S. was included in this category since a major goal of this study was to project sugar supply and demand utilizing the trade flows of major foreign countries and the emphasis of FAS was toward providing U.S. producers with analysis concerning foreign countries.

This report is an update of Phase II, and recalculates projections contained in the Phase II report by the use of an expanded data base to cover the years 1954/55 to 1975/76. This extended the data base by 2 years since the Phase II report utilized data from 1954/55 to 1973/74. The expanded data base is published in FAS publication FS3-77 entitled "World Sugar Supply and Distribution, 1954/55-1975/76."

The reason for expanding the analysis, given 2 additional years of data, was the absence of the price response of supply and distribution variables for some countries in the Phase II report. Utilizing data only through 1973/74 yielded projections of the relatively static years prior to 1973 and the sudden price increases of 1973 and 1974. The subsequent price decreases of 1975/76 were not reflected in the Phase II projections.

Figure 1 indicates the relationship between price data used in the Phase II and the Phase II update projections. With more data years reflecting price variation, it was hypothesized that a stronger statistical relationship between supply and distribution variables might be realized in the update.

The impact of High-Fructose Corn Syrups (HFCS) was not specifically addressed in this modeling effort. A detailed analysis of HFCS was contained in the Phase II report, which indicated that world production was concentrated in the U.S., EEC, and Japan and would be less than 4 million metric tons by 1985. While HFCS could be important to regional markets, it will probably account for less than 4 percent of world sugar production by 1985.¹

PROJECTION RESULTS

The equations utilized for the update were essentially the same as those utilized for Phase II, and they appear in Table 1. The one change is that no Type II equations (those testing exchange rates, exports and imports, substitute crops, and various dummy variables as explanatory variables) were utilized in the update projections. The type of equations used for each country appears in Table 1. As can be seen in Table 2, the statistical performances of the Type I equations were significantly improved by the addition of 2 years of data.

¹Based on world HFCS production of 3.8 million metric tons in 1985 compared to projected world sugar production of 100 million metric tons in 1985.

FIGURE I

ANNUAL AVERAGE WORLD SUGAR PRICES
1955-76

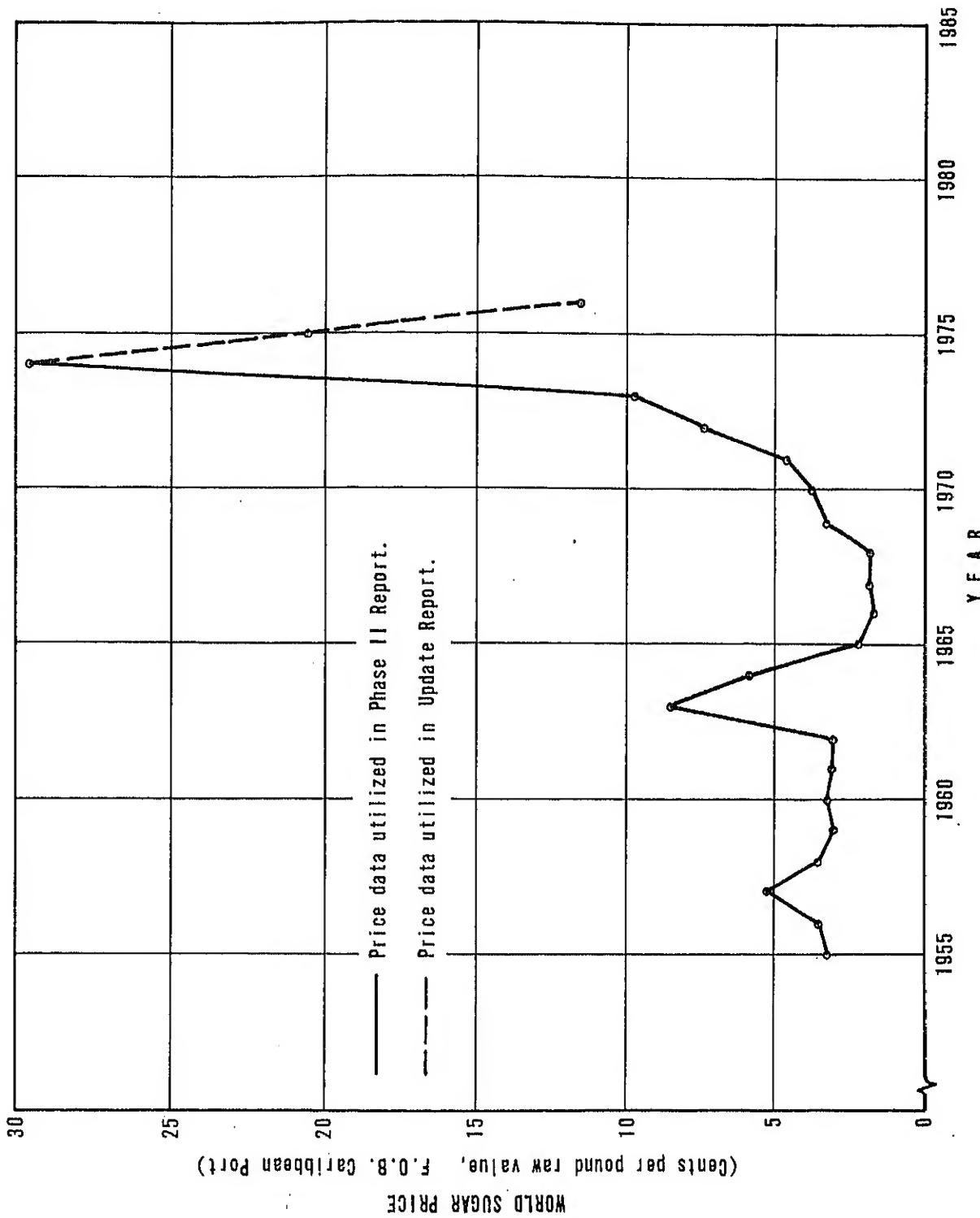


TABLE I
EQUATIONS USED IN PHASE II UPDATE WORLD SUGAR PROJECTIONS

		TYPE I	
<u>Production and Hectarage</u>			
Q_p	$= H_t Y_t$	C_t	$= c_0 + c_1 \frac{I}{N} + c_2 P$
H_t	$= b_0 + b_1 R_t$	<u>Inventories</u>	
R_t	$= K \sum_{k=1}^1 \frac{1}{K} P_{t-k} Y_{t-k}$	S_t	$= g_0 + g_1 \frac{S_{t-1}}{N} + g_2 P$
Y_t	$= a_0 + a_1 \ln t$	where: Q_D	quantity demanded (thousand metric tons)
where: Q_p	quantity produced (thousand metric tons)	$c_0, c_1, c_2, g_0, g_1, g_2$	estimated coefficients
a_0, a_1, b_0, b_1	estimated coefficients	C_t	quantity consumed (thousand metric tons)
P	price, FOB Caribbean port (cents/lb.)	S_t	quantities held in stocks at the end of a September to August crop year
H_t	hectares harvested (thousand)	C_t	per capita consumption
R_t	expected returns per acre for sugar growers	$\frac{C_t}{N}$	per capita income
Y_t	yields (metric tons/hectare)	$\frac{I}{N}$	per capita income
K	distributed lag parameters	P	price, FOB Caribbean port (cents/lb.)
t	time, 1955 = 1	I	income (U.S. dollars)
$\ln t$	the natural log of the trend variable	N	population
		t	time, 1955 = 1
<u>TYPE III</u>			
Q_p, Q_c, S_t	$= \alpha_0 + \alpha_1 t + \alpha_2 P$		
Q_p, Q_c, S_t	$= \beta_0 + \beta_1 \ln t + \beta_2 P$		
where: Q_p	quantity produced (thousand metric tons)		
Q_c	quantity consumed (thousand metric tons)		
S_t	quantities held in stocks at the end of a September to August crop year		
$\alpha_0, \alpha_1, \alpha_2, \beta_0, \beta_1, \beta_2$	estimated coefficients		
P	price, FOB Caribbean port (cents/lb.)		

TABLE 2^{1/}
EQUATIONS USED FOR PHASE II UPDATE PROJECTIONS

Country	Production	Consumption	Stocks
		Equation Type	
France	I	I	I
Italy	III	I	I
United Kingdom	I*	III	III
Federal Republic of Germany	I	I	I
Argentina	I	I	I
Australia	I	I	I
Brazil	I	I	I
Central America and Caribbean	I*	I*	III
Cuba	III	III	I
Dominican Republic	I*	I	III
India	I*	III	I
Mexico	I	I	I
Philippines	I*	III	III
Republic of China	III	I*	I
South Africa	I*	III	I
Poland	I	I	I
Indonesia	I*	I	I
USSR	I*	I	I
Iran	I	I	I
Canada	I*	I	I
Japan	I*	I	I*
Spain	III	I	I
EEC	III	III	III
Eastern Europe	III	III	III
OPEC	III	III	III
Rest of World	III	III	III

^{1/}Projections for "Major Exporters" and "Other" country group categories were made by summing the projections for the individual countries within the group.

*Projections where Type III or II equations were used in Phase II and Type I equations were used in the update due to the improved statistical performance of Type I equations with the expanded data base.

The statistical results for the Type I and Type III equations (see page 4) are shown in Tables 3 and 4, respectively. The statistics shown are the estimated coefficients, the corresponding t statistics, and R^2 for each regressor used in making the projections. The t statistics appear below the coefficients in parentheses. In almost all cases lagged dependent variables were used in making projections so that the Durbin-Watson statistic (test for autocorrelation) is not listed in the following tables for any of the estimates.

The projections for hectarage, production, consumption, inventories, and demand for the individual countries and six country groups for 1980 and 1985 appear in Tables 5 and 6, respectively. Projections for the world are also included in these tables. In order to make world projections, a "Rest of the World" category was formed. This category consists of all countries not included in a country group.

The projections are made for 1980 and 1985 with price scenarios of 7, 15 and 23 cents per pound FOB Caribbean port. Only one equilibrium price can exist for 1980 and one for 1985. Supply and demand do not equal for price scenarios used in this study. However, fluctuations in supply and demand can be observed as they move toward equilibrium as prices rise or fall. The price utilized in this update is a constant 1976 price, whereas Phase II utilized a constant 1974 price.

The "Excess Demand" and "Excess Supply" categories in Tables 5 and 6 are simply excess supply available for export or excess demand to be met by imports.

TABLE 3
REGRESSION RESULTS FOR TYPE I EQUATIONS

PRODUCTION

1 of 3

Country	Equation	Yields (Y_t)		Hectareage (A_t)		R^2	N
		a_0	a_1	R^2	b_0		
France	3.2716	1.0463 (2.839)	.30	115,255.8	91,719.07 (6.787)	.71	k = 1
Federal Republic of Germany	4.8016	.1153 (4.094)	.48	160,703.875	4,704.0508 (7.059)	.74	k = 2
Argentina	1.9568	.9436 (5.240)	.63	49,483.61	69,243.81 (5.200)	.62	k = 4
Australia	6.5577	1.4712 (4.657)	.58	63,079.3984	38,532.3906 (2.620)	.30	k = 4
Brazil	5.0497	.1048 (5.681)	.67	.16,088.2812	223,017.125 (6.683)	.74	k = 4
Mexico	3.8807	.2724 (.5440)	.04	405,744.312	46,620.7305 (4.674)	.76	k = 1
Poland	2.7668	.0734 (4.215)	.53	411,577.125	584.3674 (1.624)	.14	k = 4
Iran	1.7662	.0867 (5.004)	.57	96,809.0625	909.7405 (2.025)	.18	k = 1
Philippines	4.6877	.1533 (.2049)	.01	133,577.812	81,669.5250 (6.416)	.82	k = 1
Dominican Republic	4.6568	.1186 (5.081)	.62	135,685.312	237,8121 (2.289)	.25	k = 4
USSR	1.7078	.0530 (3.922)	.48	3,027,257.000	184,175.625 (1.327)	.10	k = 3
South Africa	7.1481	.1668 (1.109)	.11	180,351.500	37.0966 (-.4919)	.02	k = 1
Canada	3.4696	.2306 (1.577)	.14	33,070.5898	59.3341 (-.8173)	.04	k = 4
Japan	.4494	.2087 (6.636)	.72	9,105.5742	16,441.5898 (6.093)	.69	k = 3
Indonesia	4.2402	.0792 (4.662)	.63	67,817.25	21,772.9414 (7.605)	.82	k = 1
United Kingdom	3.6417	.6374 (4.851)	.60	178,469.687	146,8624 (1.456)	.12	k = 4
Indie	.9744	.0381 (5.465)	.61	2,331,714	10,343.1914 (2.369)	.23	k = 1
Central America and Caribbean	4.0888	.0325 (4.225)	.47	374,039	1,148,2590 (2.516)	.30	k = 4

CONSUMPTION

TABLE 3 (Continued)

2 of 3

Country	Equation	Income		Population		Per Capita Consumption		Price		
		d_o	d_1	R^2	f_o	f_1	R^2	c_o	c_1	c_2
France	-28,087	12,024 (10,916)	.86	43.0956 (46.386)	.99	30,965	2.6840 (5.317)	-100.6600 (-.861)	.71	
Italy	-8,338	6,372 (16,956)	.94	47.4027 (48.610)	.99	17,430	8.2450 (9.372)	-158.52 (-1.616)	.88	
Federal Republic of Germany	-44,435	16,195 (9,230)	.81	50.0706 (16,195)	.93	29,031	2.7830 (2.405)	-370.7400 (-1.135)	.26	
Argentina	1,436	1,494 (10,024)	.85	18.7100 (95.664)	.99	33,114	16.7990 (8.346)	-264.1700 (-1.047)	.86	
Australia	-8,384	3,474 (8,100)	.77	8.9878 (157.404)	.99	53,961	1.663 (2.020)	-286.51 (-1.276)	.18	
Brazil	-18,279	4,665 (7,371)	.86	55.5993 (79.467)	.99	32,715	14.802 (9.612)	-208.7200 (-2.937)	.94	
Dominican Republic	-264	128 (8,475)	.78	2.3535 (83.788)	.99	24,381	21.813 (3.141)	-108.0900 (-.595)	.47	
Mexico	-2,418	2,768 (15,766)	.93	25.9193 (29.953)	.98	25,460	20.7470 (16.665)	-117.53 (-2.969)	.95	
Indonesia	-885	933 (6,475)	.68	79.0901 (27.5985)	.98	2,889	56.686 (4.095)	-207.3200 (-1.549)	.56	
Iran	-6,299	8,774 (5,172)	.60	13.7338 (7.572)	.76	18,077	18.911 (4.184)	-634.92 (-2.639)	.58	
Canada	-7,653	5,807 (9,160)	.81	15.8252 (48.262)	.99	46,493	.1750 (.352)	-116.2300 (-.916)	.05	
Japan	-82,942	19,642 (9,312)	.81	86.6575 (46.659)	.99	15,327	5.1410 (6.018)	-271.81 (-1.707)	.74	
Spain	-13,562	3,762 (8,496)	.78	28.3669 (55.053)	.99	16,564	9.561 (8.426)	-282.9400 (-2.208)	.87	
Republic of China	-2,019	638 (16,292)	.93	8.5876 (93.194)	.99	4,735	25.561 (2.523)	-212.71 (-.6115)	.29	
USSR	53,052	16,873 (11,562)	.87	196.7334 (41.191)	.99	18,215	20.6130 (4.829)	-497.60 (-1.877)	.54	
Poland	-9,385	10,488 (32,260)	.98	25.8652 (16,624)	.93	20,773	3.4470 (21.731)	-81.56 (-1.8400)	.96	
Central American and Caribbean	-111,025	383 (5.039)	.60	15.7074 (5.049)	.71	13,190	347.2650 (10.845)	-109.99 (-1.767)	.90	

TABLE 3 (Continued)

INVENTORIES

Country	Equation	ϵ_0	Beginning Stocks ϵ_1	Price ϵ_2	R ²	Country	ϵ_0	Beginning Stocks ϵ_1	Price ϵ_2	R ²
France	- 7,428	-2966 (1.609)	-238.59 (-1.400)	.25		Republic of China	3,729	.5168 (2.523)	-145.566 (-.612)	.29
Italy	6,374	.3811 (2.215)	-72.38 (-.8746)	.23		South Africa	7,023	.1829 (.800)	-23.726 (-.192)	.03
o Federal Republic of Germany	3,889	-1838 (1.052)	-87.51 (-.766)	.12		Poland	4,113	.3748 (1.422)	-11.726 (-.118)	.10
Argentina	5,368	-.5316 (2.754)	-214.30 (-1.318)	.45		Indonesia	121	1.0074 (16.822)	-12.955 (-.720)	.94
Australia	6,740	.6664 (3.022)	-68.56 (-.200)	.34		Iran	3,099	.8702 (5.968)	-87.041 (-.575)	.78
Brazil	2,446	.8996 (9.867)	-76.425 (-1.034)	.84		Canada	3,758	.5308 (2.926)	-32.745 (-.680)	.31
Cuba	89,429	.6094 (4.228)	-892.691 (-.270)	.53		Spain	2,986	.5660 (2.841)	-60.944 (-1.228)	.35
India	934	.8276 (7.412)	-54.334 (-1.570)	.79		USSR	1,695	.7469 (4.940)	-68.831 (-1.058)	.59
Mexico	1,890	-.8778 (6.137)	-85.807 (-.992)	.67		Japan	1,763	.1863 (.800)	-18.653 (-.676)	.07

TABLE 4
REGRESSION RESULTS FOR TYPE III EQUATIONS

Country	Equation	Production (1000 mt)				Consumption (1000 mt)				Stocks (1000 mt)					
		Constant	Time	Price	R ²	Constant		Time	Price	R ²	Constant		Time	Price	R ²
						Price	R ²				Price	R ²			
Italy		968,637	17,992 (2,478)	N.S. ^{1/}	.36	2,706,519	66,855 (2,086)	-2,464.65 (-.6237)	.19	212,878	50,284 (1,934)	-5,165 (-1,490)	.21		
United Kingdom															
Central America and Caribbean															
Cuba	3,442,446	120,288 (2,756)	N.S.	.39	253,272	21,402 (5,143)	-3,955 (-.9865)	.63		73,152	16,411 (4,771)	-1,157 ^{2/} (-2,524)	.59		
Dominican Republic															
India															
Philippines															
10 Republic of China	45,847	12,267 (6,385)	N.S.	.58		209,519	28,245 (15,193)	-3,800 (-.880)	.95		54,598	11,142 (5,656)	N.S.	.72	
South Africa															
Spain	174,399	194,782 (5,282)	.678 (.148)	.64											
Rest of the World	6,441,072	4,506,971 (18,097)	118,538 (1,744)	.84	12,302,070	584,647 (38,586)	W.S.	.99	3,181,448	153,766 (8,151)	-40,632 (-2,233)	.89			
EEC	4,285,116	1,427,532 (5,623)	46,417 (1,497)	.72	7,644,923	166,039 (12,503)	-6,453 (-.5040)	.92	1,518,109	27,734 (2,035)	-34,304 (-2,610)	.53			
Eastern Europe	2,885,091	639,772 (5,723)	1,664 (.1183)	.82	2,195,117	150,749 (33,270)	W.S.	.95	551,298	30,848 (5,897)	-18,627 (-3,673)	.65			
OPEC ^{4/}	798,316	62,305 (9,001)	12,510 (1,863)	.88	883,411	72,260 (13,624)	W.S.	.93	791,177	100,348 (1,755)	-19,028 (-2,497)	.30			

^{1/} N.S. = Did not enter the stepwise regression at an exclusion level of .95.

^{2/} W.S. = Variable was excluded since implausible signs were obtained with inclusion.

^{3/} Price lagged 2 years.

^{4/} Some OPEC member countries were included in the data series in an "Other Africa" or "Other Asia" category. These countries were projected separately and added to the estimates yielded by the above equations. The values of the countries projected separately were then subtracted from projections for the "Rest of the World."

Note: Other and major exporter category projections were estimated by adding the separate projections of countries in these categories; therefore no regression results are listed.

TABLE 5
PROJECTIONS OF WORLD SUPPLY AND DEMAND FOR SUGAR
1980

Country	Price Scenario (e/lb)	Hectares (1000 hectares)	Production	Beginning Inventories	Supply	Excess Supply	Consumption	Ending Inventory	Demand	Excess Demand	1 of 3
							-(1000 mt)				
France	7	424	3,052	444	3,496	603	2,442	451	2,893	-	-
	15	587	3,945	299	4,244	1,544	2,398	302	2,700	-	-
	23	661	4,445	194	4,599	2,093	2,353	153	2,506	-	-
Italy ^{1/}	7	-	-	539	1,993	-	2,238	543	2,781	788	-
	15	289	1,454	489	1,943	-	2,164	491	2,655	712	-
	23	-	-	438	1,892	-	2,091	438	2,529	637	-
United Kingdom ^{2/}	7	184	1,058	-	1,176	-	2,907	230	3,137	1,961	-
	15	191	1,097	118	1,215	-	2,888	225	3,113	1,898	-
	23	198	1,135	-	1,253	-	2,868	219	3,087	1,834	-
Federal Republic of Germany	7	348	2,756	265	3,021	-	2,806	267	3,073	52	-
	15	422	3,337	209	3,546	727	2,609	210	2,819	-	-
	23	463	3,663	153	3,816	1,251	2,412	153	2,565	-	-
Argentina	7	266	1,346	203	1,549	226	1,111	212	1,323	-	-
	15	350	1,775	121	1,896	679	1,095	122	1,217	-	-
	23	398	2,016	39	2,055	945	1,078	32	1,110	-	-
Australia	7	245	2,791	346	3,137	1,917	898	322	1,220	-	-
	15	316	3,602	330	3,932	2,764	865	303	1,168	-	-
	23	356	4,057	313	4,370	3,255	831	284	1,115	-	-
Brazil	7	865	6,816	1,520	8,336	1,564	5,180	1,392	6,772	-	-
	15	1,210	9,535	1,333	10,868	4,531	4,985	1,352	6,337	-	-
	23	1,404	11,060	1,147	12,207	6,006	4,789	1,112	5,901	-	-
Central America and Caribbean ⁷	7	413	2,053	159	2,212	1,332	718	162	880	-	-
	15	453	2,276	158	2,434	1,578	695	161	856	-	-
	23	503	2,498	157	2,655	1,823	672	160	832	-	-
Cuba ^{1/}	7	-	-	343	6,913	5,756	803	354	1,157	-	-
	15	1,540	6,570	314	6,884	5,786	772	326	1,098	-	-
	23	-	-	285	6,555	5,817	740	298	1,038	-	-
Dominican Republic	7	148	1,165	228	1,393	571	189	233	422	-	-
	15	163	1,279	205	1,484	1,089	185	210	395	-	-
	23	177	1,391	181	1,552	1,206	180	186	366	-	-

TABLE 5 (Continued)

1980

Country	Price Scenario (c/1b)	Hectarage (1000 hectares)	Production	Beginning Inventories		Supply (1,000 mt)	Excess Supply (1,000 mt)	Consumption	Ending Inventory	Demand	Excess Demand
				Scenario	Actual						
India ^{2/} ^{3/}	7	2,474	4,956	—	5,890	—	5,238	1,102	6,340	450	
	15	2,637	5,281	934	6,215	25	—	6,190	6,071		
	23	2,799	5,607	—	6,541	470	—	833	6,071		
Mexico	7	547	2,616	406	3,022	—	2,802	442	3,244	222	
	15	603	2,881	292	3,173	137	2,740	296	3,036		
	23	634	3,030	177	3,207	379	2,678	150	2,828		
Philippines ^{3/}	7	395	2,052	—	2,402	1,101	946	—	1,301		
	15	498	2,584	350	2,934	1,664	915	355	1,270		
	23	555	2,883	—	3,233	1,993	885	—	1,240		
Republic of China	7	114	945	85	1,030	510	429	91	520		
	15	126	1,044	50	1,094	642	399	53	452		
	23	138	1,142	15	1,157	773	370	14	384		
South Africa ^{2/}	7	183	1,835	226	2,061	766	—	231	1,295		
	15	186	1,865	220	2,085	796	1,064	225	1,289		
	23	189	1,894	214	2,108	826	—	218	1,282		
Poland	7	430	2,043	241	2,284	162	1,887	235	2,122		
	15	452	2,144	236	2,380	322	1,829	229	2,058		
	23	473	2,246	231	2,477	483	1,770	224	1,994		
Indonesia	7	145	930	399	1,329	—	1,532	406	1,938	609	
	15	176	1,125	355	1,480	—	1,293	347	1,640	160	
	23	194	1,234	312	1,546	203	1,054	289	1,343		
Iran	7	122	503	386	889	—	2,423	915	3,338	2,449	
	15	152	623	440	953	—	1,677	1,010	2,687	1,734	
	23	181	743	274	1,017	—	932	1,105	2,037	1,020	
Canada	7	35	147	182	329	—	1,152	183	1,335	1,006	
	15	37	156	170	326	—	1,129	171	1,300	974	
	23	39	164	159	323	—	1,106	158	1,264	941	
Japan	7	74	571	230	801	—	3,757	232	3,989	3,188	
	15	99	766	209	975	—	3,505	211	3,716	2,741	
	23	113	876	189	1,065	—	3,252	190	3,442	2,378	

TABLE 5 (Continued)

1980

3 of 3

Country	Price Scenario (€/lb)	Hectareage (1000 hectares)	Production	Beginning Inventories	Supply ---(1000 mt)	Excess Supply	Consumption	Ending Inventory	Demand	Excess Demand
Spain	7	203	814	198	1,012	-	1,347	207	1,554	542
	15	210	819	165	984	-	1,263	170	1,333	449
	23	216	825	131	956	-	1,179	133	1,312	356
Rest of the World ^{2/}	7	5,707	21,954	8,102	30,056	-	32,660	7,943	40,603	9,917
	15	5,954	22,902	7,784	30,686	-	-	7,618	40,278	8,961
	23	6,200	23,851	7,466	31,317	-	-	-	-	-
EEC	7	1,774	11,704	1,638	13,342	-	12,561	2,027	14,568	1,246
	15	1,787	11,992	1,567	13,559	-	12,873	1,752	14,625	1,066
	23	1,801	12,179	1,512	13,691	29	12,184	1,478	13,662	-
Major Exporters	7	7,190	33,145	4,847	37,992	13,728	19,318	4,946	24,264	-
	15	8,087	38,692	3,954	42,646	19,653	18,953	4,035	22,388	-
	23	8,693	42,148	3,686	45,834	23,548	18,325	3,761	22,286	-
East Europe ^{2/}	7	1,456	4,981	982	5,963	-	-	997	7,357	1,394
	15	1,461	4,994	881	5,875	-	6,380	901	7,261	1,386
	23	1,464	5,006	791	5,797	-	-	804	7,164	1,367
OPEC	7	572	2,660	1,360	4,020	-	4,409	1,361	5,770	1,750
	15	594	2,760	1,208	3,968	-	4,199	1,210	5,409	1,441
	23	595	2,768	1,055	3,823	-	3,989	1,057	5,046	1,223
USSR	7	3,455	10,750	1,067	11,817	-	14,128	1,126	15,254	3,437
	15	3,581	11,239	730	11,969	-	13,049	725	13,774	1,805
	23	3,688	11,513	392	11,905	-	11,971	323	12,294	389
Other ^{4/}	7	312	1,532	610	2,142	-	6,256	622	6,878	4,736
	15	346	1,741	544	2,285	-	5,897	552	6,449	4,164
	23	368	1,865	479	2,344	-	5,537	481	6,018	3,674
World Totals		7	20,436	86,726	18,606	105,332	-	95,692	19,347	115,039
		15	21,810	94,320	16,668	110,988	-	93,991	17,118	111,109
		23	22,739	99,330	15,381	114,711	7,963	91,225	15,522	106,748

^{1/} No significant price variable in the production equation.^{2/} No significant price variable in the consumption equation.^{3/} No significant price variable in the inventory equation.^{4/} Canada, Japan, and Spain.

TABLE 6
PROJECTIONS OF WORLD SUPPLY AND DEMAND FOR SUGAR
1985

Country	Price Scenario (c/lb)	Hectarage (1000 hectares)	Production	Beginning Inventories	Supply (1000 mt)	Excess Supply	Consumption	Ending Inventory	Demand	Excess Demand	1 of 3		
											7	15	23
France	7	459	3,167	468	3,635	487	2,676	472	3,148	-	-	-	-
	15	594	4,096	313	4,009	1,464	2,629	316	2,945	-	-	-	-
	23	669	4,617	158	4,775	2,034	2,582	159	2,741	-	-	-	-
Italy ^{1/}	7	-	-	559	2,103	-	2,532	562	3,094	991	-	-	-
	15	305	1,544	504	2,048	-	2,457	507	2,964	916	-	-	-
	23	-	-	449	1,993	-	2,381	451	2,832	839	-	-	-
United Kingdom ^{3/}	7	184	1,079	-	1,200	-	2,919	278	3,197	1,997	-	-	-
	15	191	1,119	121	1,240	-	2,899	273	3,172	1,932	-	-	-
	23	198	1,153	-	1,280	-	2,880	267	3,147	1,867	-	-	-
Federal Republic of Germany	7	355	3,012	277	3,289	-	3,115	279	3,394	105	-	-	-
	15	431	3,658	218	3,876	747	2,909	220	3,129	-	-	-	-
	23	473	4,020	158	4,178	1,316	2,702	160	2,862	-	-	-	-
Argentina	7	270	1,413	230	1,643	208	1,203	232	1,435	-	-	-	-
	15	357	1,865	128	1,903	678	1,185	130	1,315	-	-	-	-
	23	405	2,119	27	2,146	952	1,167	27	1,194	-	-	-	-
Australia	7	246	2,791	294	3,085	1,807	984	294	1,278	-	-	-	-
	15	318	3,710	270	3,980	2,762	948	270	1,218	-	-	-	-
	23	358	4,179	246	4,425	3,268	912	245	1,157	-	-	-	-
Brazil	7	894	7,512	1,854	9,366	1,560	5,892	1,914	7,806	-	-	-	-
	15	1,250	10,507	1,337	11,944	4,807	5,076	1,461	7,137	-	-	-	-
	23	1,450	12,187	1,021	13,208	6,740	5,461	1,097	6,468	-	-	-	-
Central America and Caribbean	7	415	2,127	119	2,246	1,378	748	120	868	-	-	-	-
	15	461	2,364	109	2,473	1,637	725	111	836	-	-	-	-
	23	507	2,602	98	2,700	1,898	701	101	802	-	-	-	-
Cuba ^{1/}	7	-	-	343	7,514	6,257	910	347	1,257	-	-	-	-
	15	1,593	7,171	308	7,479	6,300	879	314	1,179	-	-	-	-
	23	-	-	285	7,456	6,328	847	281	1,128	-	-	-	-
Dominican Republic	7	149	1,262	243	1,505	1,041	216	248	464	-	-	-	-
	15	165	1,393	220	1,613	1,177	211	225	436	-	-	-	-
	23	180	1,524	197	1,721	1,313	206	202	408	-	-	-	-

TABLE 6 (Continued)

1985

Country	Price Scenario (c/lb)	Hectareage (1000 hectares)	Production	Beginning Inventories	Supply (1000 mt)	Excess Supply	Consumption	Ending Inventory	Demand	Excess Demand
India 2/ 3/	7	2,488	5,457	—	6,479	—	5,954	1,417	7,731	852
	15	2,666	5,848	1,022	6,870	—	1,039	6,993	123	
	23	2,844	6,240	—	7,262	36	—	954	6,908	—
Mexico	7	548	2,646	564	3,210	—	3,228	590	3,818	608
	15	604	2,915	317	3,232	—	3,158	322	3,480	248
	23	636	3,066	69	3,135	—	3,089	55	3,144	9
Philippines 3/	7	396	2,067	—	2,475	977	1,087	—	1,498	—
	15	499	2,603	408	3,011	1,544	1,056	411	1,467	—
	23	557	2,904	—	3,312	1,875	1,026	—	1,437	—
Republic of China	7	114	948	102	1,050	430	516	104	620	—
	15	126	1,047	58	1,105	562	493	60	543	—
	23	138	1,146	15	1,161	695	451	15	466	—
South Africa 2/	7	183	1,934	251	2,185	766	—	256	1,419	—
	15	186	1,967	244	2,211	801	1,162	248	1,410	—
	23	189	2,000	237	2,237	833	—	241	1,404	—
Poland	7	432	2,209	238	2,447	68	2,139	240	2,379	—
	15	455	2,227	233	2,560	253	2,013	234	2,307	—
	23	478	2,445	227	2,672	436	2,007	229	2,236	—
Indonesia	7	148	1,005	437	1,442	—	1,815	445	2,260	818
	15	180	1,219	313	1,532	—	1,555	304	1,859	327
	23	198	1,339	163	1,502	—	1,295	163	1,158	1,123
Iran	7	125	568	493	1,061	—	2,801	508	3,309	2,248
	15	158	716	381	1,097	—	1,926	389	2,315	1,238
	23	190	863	269	1,132	—	1,050	269	1,319	187
Canada	7	35	149	193	342	—	1,234	195	1,429	1,087
	15	37	157	179	336	—	1,210	181	1,391	1,055
	23	39	166	164	330	—	1,165	167	1,552	1,022
Japan	7	76	612	241	853	—	4,338	244	4,582	3,729
	15	102	822	219	1,041	—	4,073	221	4,294	3,753
	23	116	941	197	1,138	—	3,869	199	4,008	2,870

TABLE 6 (Continued)

1985

Country	Price Scenario (€/lb)	Hectarage (1000 hectares)	Production	Beginning Inventories	Supply (1000 mt)	Excess Supply		Consumption	Ending Inventory	Demand	Excess Demand
						Supply	Excess Supply				
Spain	7	207	848	224	1,072	-	1,552	226	1,778	706	
	15	214	853	181	1,034	-	1,454	183	1,647	613	
	23	220	859	139	998	-	1,376	140	1,516	518	
Rest of the World ^{2/}	7	6,390	25,748	8,847	31,595	-	9,037	45,397	13,862		
	15	6,659	23,636	8,320	32,016	-	26,350	8,711	45,701	13,685	
	23	6,923	24,644	7,871	32,515	-	-	8,385	44,746	12,231	
EEC	7	1,900	12,512	2,101	14,613	-	13,512	2,165	15,677	1,064	
	15	1,914	12,884	1,889	14,773	-	13,316	1,891	15,207	1,434	
	23	1,927	13,255	1,572	14,827	90	13,120	1,617	14,737	-	
Major Exporters	7	7,296	35,328	5,506	40,834	13,379	21,900	5,555	27,455	-	
	15	7,775	41,390	4,050	45,440	20,987	21,437	4,090	25,527	-	
	23	8,857	45,138	3,584	48,722	24,122	20,976	3,624	24,600	-	
East Europe ^{2/}	7	1,548	5,093	992	6,085	-	7,139	1,034	8,173	2,088	
	15	1,551	5,105	871	5,977	-	-	1,937	8,076	2,099	
	23	1,556	5,119	790	5,909	-	-	842	7,981	2,072	
OPEC	7	638	2,986	1,368	4,354	-	4,957	1,370	6,327	1,973	
	15	659	3,086	1,216	4,302	-	4,721	1,218	5,939	1,637	
	23	681	3,186	1,064	4,250	-	4,485	1,066	5,551	1,301	
USSR	7	3,455	11,760	1,272	13,032	-	16,077	1,300	17,377	4,345	
	15	3,622	12,330	729	13,059	-	14,542	734	15,676	2,617	
	23	3,716	12,650	186	12,836	-	13,807	171	13,978	1,142	
Other ^{4/}	7	318	1,609	658	2,267	-	7,124	665	7,789	5,536	
	15	353	1,832	579	2,411	-	6,747	585	7,322	4,932	
	23	375	1,966	500	2,466	-	6,370	506	6,876	4,419	
World Totals	7	21,545	92,036	20,744	112,780	-	107,069	21,126	128,195	15,415	
	15	22,533	100,324	17,654	117,978	-	104,662	18,166	123,458	5,480	
	23	24,035	105,958	15,567	12,535	3,955	102,257	16,712	118,469	-	

^{1/} No significant price variable in the production equation.^{2/} No significant price variable in the consumption equation.^{3/} No significant price variable in the inventory equation.^{4/} Canada, Japan, and Spain.

SUMMARY AND CONCLUSIONS

The world sugar economy is a complicated maze of government policies, trade arrangements, and different consumption patterns. No one equation or set of equations can completely explain the world sugar economy and no such attempt was made in this study. What is attempted is to provide projections for production, demand, and hectarage for 1980 and 1985 using different price scenarios and economically and statistically sound equations to estimate variable parameters.

This update study has utilized much of the information in the Phase II study. The reader is referred to the Phase II document for complete background information on methodology and data sources.

Graphical derivations of the supply and demand situations for 1980 and 1985 appear in Figures 2 and 3. The data utilized to construct these supply and demand curves, which were taken from Tables 5 and 6, appear in Tables 7 and 8.

The excess supply figures for the world totals represent additional carry-over inventories in excess of those necessary for "working" inventories in the world supply and demand situation. Excess supply would serve to decrease production and along with the low supply price, force supply towards the equilibrium level.

The excess demand figures for the world totals theoretically estimate demand in excess of supply. This amount would represent the amount of inventories over and above "working" inventories necessary to meet world demand — an undersupply situation like the disequilibrium that contributed to the rapid price increase in 1974-75.

This analysis indicates an estimated equilibrium price for 1980 of 15.6 cents per lb and for 1985 of 20.2 cents per lb, with supply and demand equilibrium levels of 110.7 million MT and 120.2 million MT, respectively, for 1980 and 1985.

FIGURE 2
GRAPHICAL DERIVATION OF EQUILIBRIUM
WORLD SUGAR PRICE FOR 1980

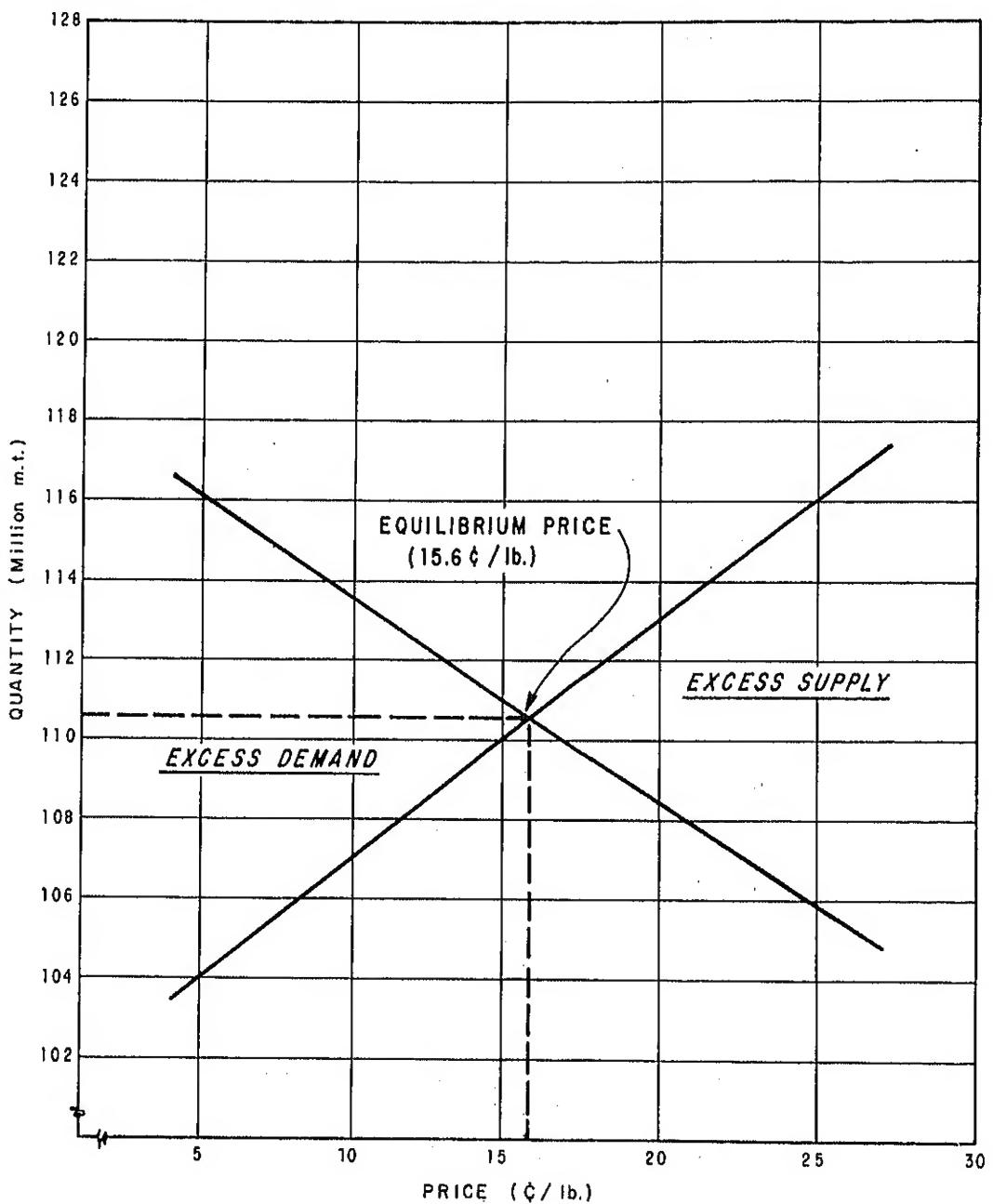


FIGURE 3
GRAPHICAL DERIVATION OF EQUILIBRIUM
WORLD SUGAR PRICE FOR 1985

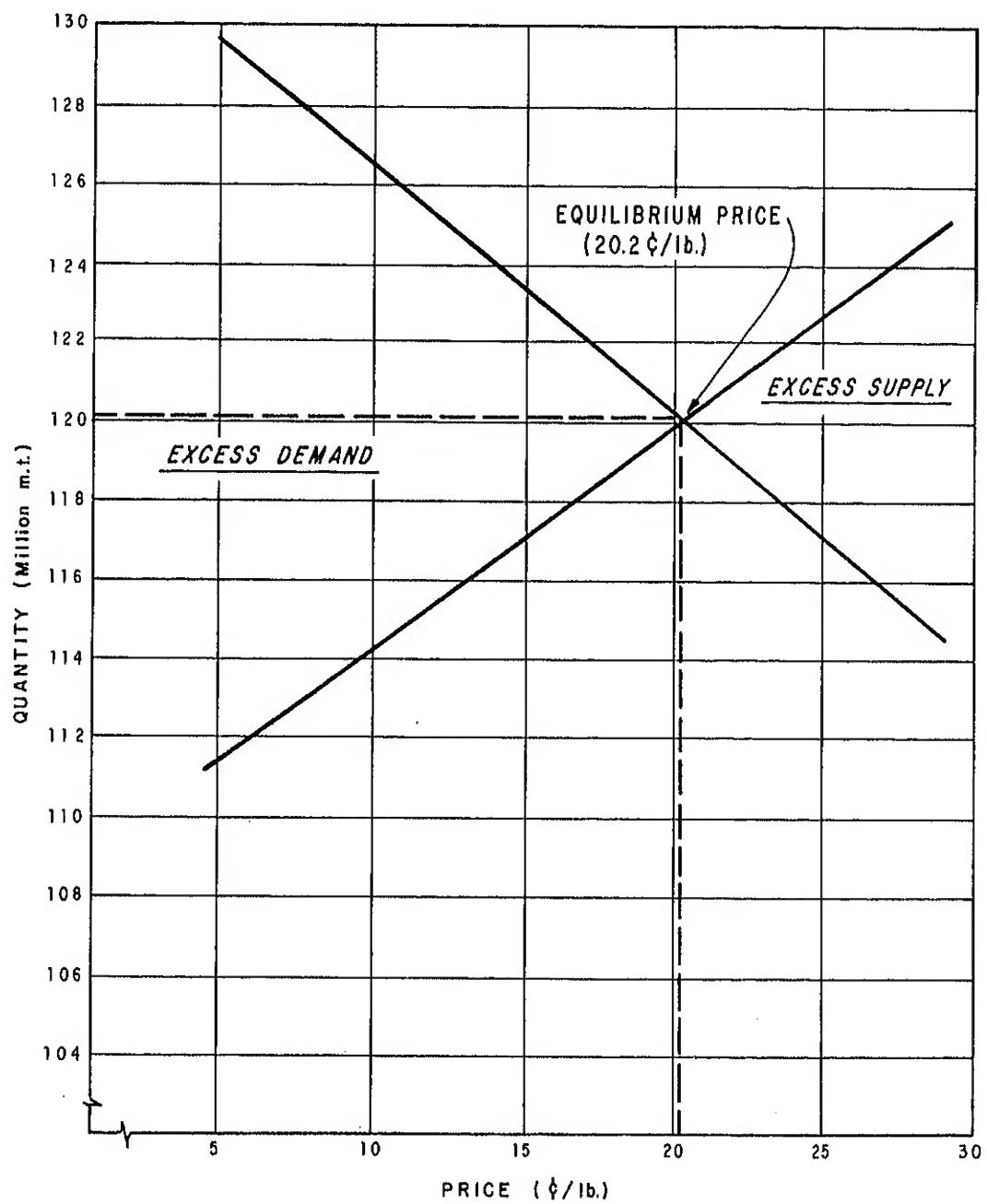


TABLE 7
 EQUILIBRIUM SUPPLY AND DEMAND SITUATION FOR THE
 WORLD SUGAR ECONOMY IN 1980

Price (¢/lb)	Supply ^{1/}	Excess Supply ----- million metric tons-----	Demand ^{2/}	Excess Demand
7	105.3	--	115.0	9.7
15	110.0	0	111.1	1.1
15.6 ^{3/}	110.7	--	110.7	--
23	114.7	8.0	106.7	--

1/ Supply = quantity produced and beginning inventories

2/ Demand = quantity consumed and ending inventories

3/ Denotes equilibrium price

TABLE 8
EQUILIBRIUM SUPPLY AND DEMAND SITUATION FOR THE
WORLD SUGAR ECONOMY IN 1985

Price (\$/lb)	Supply ^{1/}	Excess Supply million metric tons	Demand	Excess ^{2/} Demand
7	112.8	--	128.2	15.4
15	118.0	--	123.5	5.5
20.2 ^{3/}	120.2	--	120.2	--
23	121.5	3.0	118.5	--

1/ Supply = quantity produced and beginning inventories

2/ Demand = quantity consumed and ending inventories

3/ Denotes equilibrium price

Other important findings of this study are as follows:

- Historically, sugar producers and consumers have responded to changes in price; however, some countries do not respond directly to market and economic forces and, for them, supply and demand are difficult to project using equations reflecting price and other economic variables.
- There is evidence that a sugar supply and demand "cycle" do exist.

Evidence of Price Response

A key variable in each of the supply and distribution equations tested was world price. Out of the 63 equations tested for the individual countries, only one country did not respond to price according to theoretical economic considerations (see Table 4). This was the Dominican Republic, which appeared to increase stocks as price increased, contrary to the hypothesized relationship.

This was probably due to the Dominican Republic's traditional reliance on the U.S. market. Maintenance of the U.S. market is important to the sugar industry in this country. Stocks are manipulated for U.S. market maintenance as opposed to maximizing revenues on the open market.

Six other countries did not respond to price as expected. In the equations for these countries, price did not enter a stepwise regression at an inclusion level of .95. They were as follows:

<u>Country</u>	<u>Variable</u>
-- Italy	Production
-- Cuba	Production and consumption
-- Philippines	Stocks
-- Republic of China	Production
-- South Africa	Consumption
-- India	Consumption

Italy is a regular deficit EEC country in sugar production. As such, Italy receives a high derived intervention price designed to encourage production. This creates a large subsidy for production and reflects high production costs. Production costs are such that import sugar can cost considerably less than Italian sugar. The effects of a subsidy and high production costs distort the effects of world price on production decisions and leave world price as an insignificant influence on Italian sugar production decisions.

Cuba's production and consumption situation are regulated by the government. The effects of changing politics in Cuba have caused many fluctuations in the Cuban sugar industry. The embargo on Cuban exports by the United States that began in 1960 produced dramatic changes in the Cuban sugar production situation. An additional problem in projecting Cuban sugar production was encountered in 1970, when production increased by over 54 percent in 1 year due to a government decision to increase sugar production. These and other periodic changes in the Cuban political and trade situation overrode price as a critical explanatory variable for production and consumption in Cuba.

The Philippines, like the Dominican Republic, has traditionally been dependent on the U.S. market. Through 1974 the government attempted to meet the U.S. sugar quota and in some years has had difficulty in reaching this goal. The government has also been known to hold stocks as a speculative move to obtain a higher price. This occurred in 1976. These reasons and others related to control by the Philippine government indicate that their stock management policies cannot be explained by world price.

The Republic of China has had very stable sugar production. Production in 1955 was 755,000 metric tons (raw value) as compared to 819,000 in 1976. The average production over this time period was 856,000 metric tons. Production in the Republic of China is price inelastic and yielded a statistically insignificant price variable for projection purposes.

South Africa's domestic sugar consumption data have been influenced by the injection of brown sugar into the consumer market in 1959/60 and the subsequent growth of consumption by 153,000 metric tons since that time. Data showing the growth of brown sugar consumption are shown in Table 9.

TABLE 9
SOUTH AFRICAN
DOMESTIC SUGAR CONSUMPTION

(in metric tons)

Year	White	Brown	Total
1955-56	593,508	---	593,508
1956-57	610,105	---	610,105
1957-58	659,521	---	659,521
1958-59	657,474	---	657,474
1959-60	526,101	12,492	655,837
1960-61	561,026	113,615	674,641
1961-62	553,234	122,575	675,809
1962-63	559,189	116,559	675,748
1963-64	601,582	122,854	724,436
1964-65	624,821	127,084	751,905
1965-66	646,909	131,890	778,799
1966-67	638,377	122,243	760,620
1967-68	627,705	106,757	734,462
1968-69	661,459	108,113	769,572
1969-70	678,459	112,012	790,471
1970-71	716,474	118,931	835,405
1971-72	746,154	124,739	870,893
1972-73	777,908	131,144	909,052
1973-74	835,184	145,618	980,802
1974-75	899,063	154,286	1,053,349
1975-76	957,059	164,372	1,121,431
1976-77	980,499	165,141	1,145,640

Source: The South African Sugar Year Book 1976-77

The addition of brown sugar to the consumption picture resulted in further increases in total sugar consumption.

Data utilized in testing the projection equations were for white sugar only. The influx of brown sugar consumption has affected white sugar consumption. As a result, the time series data were reflecting two different variables, one variable for white sugar consumption and the other for brown sugar consumption. This situation could have affected the consumption projection estimates, since a data error was apparent in the series used for the estimates.

Of greater importance, however, is the direct government intervention in domestic retail market supply and prices. The domestic retail market price is fixed by the government and it is insulated from the swings in the international market price. The result is that domestic consumption is not influenced by world price.

India's consumption of white sugar is heavily influenced by the production of artisan non-centrifugal sugars. In fact, non-centrifugal sugars typically account for almost three-fourths of domestic consumption. There is direct competition between the two, with domestic price and government policy being important determinants of the consumption levels of each sugar type. The result is a world price variable that is statistically insignificant due to the domestic competition between white and non-centrifugal sugars and government price intervention.

Another relationship that should be mentioned is the demand situation for Mexico. The supply totals for Mexico in 1985 at first glance seem to indicate that as price increases supply decreases but demand increases. This is contrary to a priori economic knowledge and the projection results obtained for other countries. A closer look at the Mexican projections reveals that the expected relationships between price and the other variables actually do hold. Supply is defined as the sum of production and beginning inventories. Demand is defined as the sum of consumption and ending inventories. All four variables showed statistically significant response to price in the direction that should be expected; i.e. positive for production and negative for consumption and inventories. However, inventories have a much stronger response to price than does production. When supply is calculated the results are that supply declines as price increases due to a decrease in inventories that is greater than the increase in production. The signs in the projection equations were as hypothesized and correct, even though the supply and demand totals seem to defy a priori assumptions.

Evidence of a Sugar Cycle

A 22-year data series (1955 through 1976), such as was used for this study, is probably not sufficient to draw conclusions about a sugar cycle; however, some interesting relationships can be noted. The evidence available consists of the patterns of historical price fluctuations, the historical residuals of world production and consumption, and the derived equilibrium prices for 1980 and 1985 as a result of this study.

Figure 1 on page 3 plotted world prices from 1955 through 1976. As can be seen from this information, prices seem to fit into a 6-year cycle as indicated by the high points on this chart. The cycle years would end and begin in 1956/57, 1962/63, 1968/69 and 1974/75.

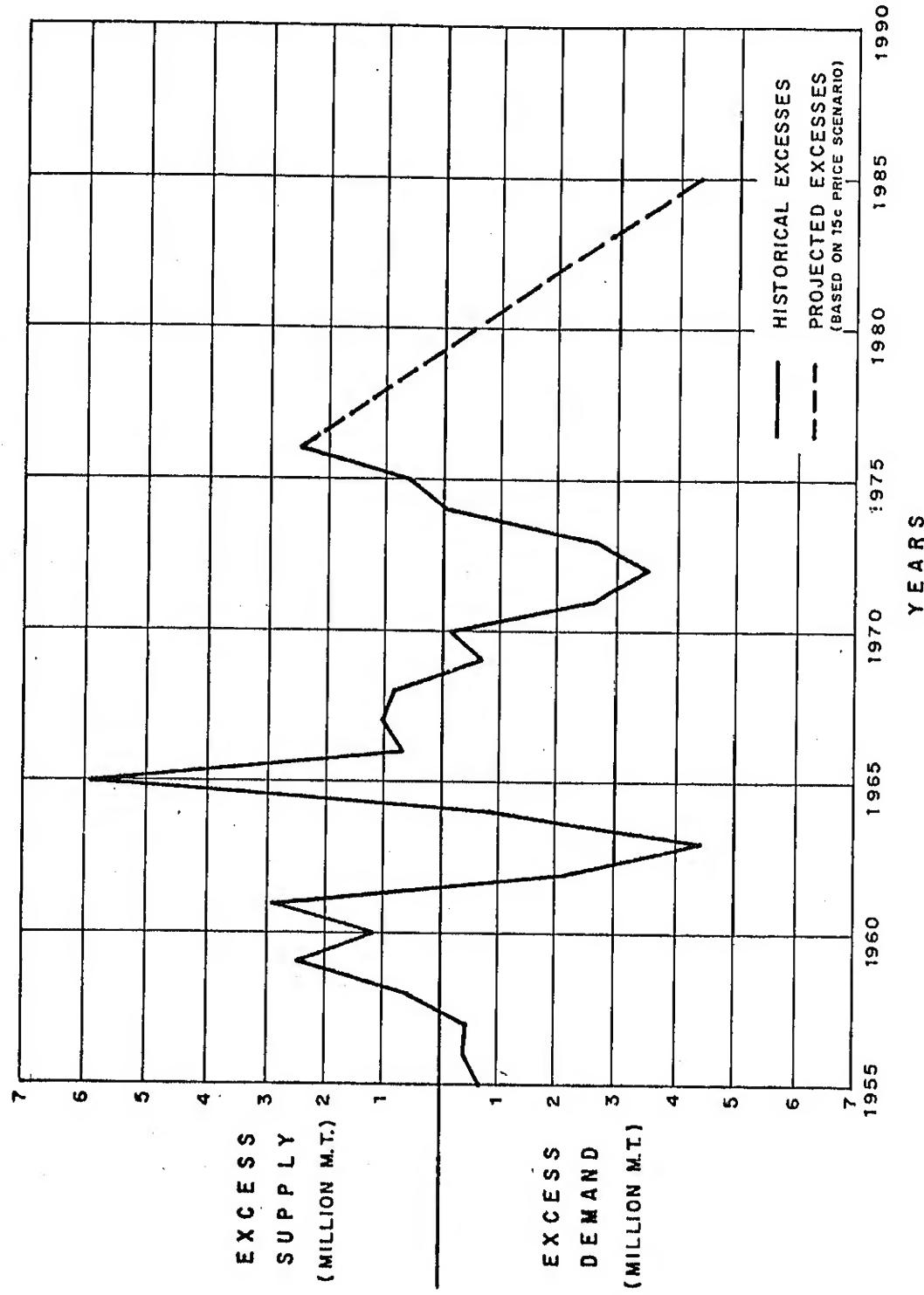
Production and consumption are closely related to world prices in most countries. Given a price cycle, a pattern in production and consumption should exist due to relationships between production, consumption and prices. Historical excess supply and excess demand are plotted in Figure 4. According to the high points in Figure 4, a production and consumption cycle does seem to exist. High points for excess supply (supply less demand) seem to occur approximately 2 years after high points in world price.

Excess supply and demand calculated from the 1980 and 1985 projections indicate a continuance of past cycles (dotted line on Figure 4). Based on a 15 cent^{1/2} scenario, demand in 1980 should be exceeding supply and prices will begin to rise. This will be a result of production decisions based on world prices which began to fall in 1975 and demand which will respond to lower prices. According to past cycles, 1985 is probably close to the height of a period of excess demand.

The notion of a sugar supply and distribution cycle corresponds to economic equilibrium theory in that as price is bid up by excess demand production is stimulated. As supply rises, prices fall and again stimulate demand. The economic forces that cause the cycle and resulting price fluctuations probably can not be controlled by the actions of individual governments. However, knowledge of the cyclic nature of world sugar supply and demand can be a valuable tool when planning sugar production and marketing strategies.

FIGURE 4

HISTORICAL AND PROJECTED EXCESS SUPPLY AND DEMAND 1955 - 1985



PHASE II

ERRATA

The following are errata for the Phase II study entitled "Report on World Sugar Supply and Demand, 1980 and 1985," published in November 1977.

1. There was a typographical error on Table 42, page 279, concerning consumption for the "Rest of the World" category. This did not affect the World Totals, which remain the same. The corrected Table 42 page is reproduced on page 30 of this report.
2. The price utilized in the November 1977 study was a constant 1974 price.
3. Tables 18 and 19 in the Phase II Report on Nicaraguan production costs should have cited the following source: Dr. Philip F. Warnken, "Production Costs and Returns for Major Agricultural Products of Nicaragua; Data Tables for 1972 and 1975."

TABLE 42 (Continued)

Country	Price Scenario (\$/lb)	Hectarage (1000 hectares)	Production	Beginning Inventories		Excess Supply (1000 mt)	Consumption (1000 mt)	Ending Inventory	Demand	Excess Demand
				Supply	Excess Supply					
Spain	7	207	848	243	1,091	-	1,564	245	4,809	3,718
	15	214	876	221	1,097	-	1,438	223	1,661	564
	23	220	904	199	1,103	-	1,312	201	1,513	410
Rest of the World ^{1/}	7	6,659	25,299	8,745	34,044	-	36,160	8,937	45,097	11,053
	15	-	-	8,240	33,339	-	-	8,531	44,691	11,252
	23	-	-	7,734	33,033	-	-	7,990	44,150	11,117
EEC	7	1,900	12,439	1,943	14,382	-	13,512	1,994	15,506	1,124
	15	1,914	12,526	1,846	14,372	-	13,316	1,892	15,208	836
	23	1,927	12,614	1,684	14,298	-	13,120	1,709	14,829	531
Major Exporters	7	8,803	33,155	7,331	40,486	11,577	21,514	7,395	28,909	-
	15	10,944	41,317	6,539	47,856	20,126	21,28	6,402	27,730	-
	23	13,084	49,478	5,746	55,224	28,572	20,742	5,810	26,552	-
East Europe	1,551	5,988	724	6,712	-	7,139	733	7,872	1,160	
OPEC	7	638	2,986	1,268	4,354	-	4,957	1,370	6,327	1,973
	15	659	3,086	1,216	4,302	-	4,721	1,218	5,939	1,637
	23	681	3,186	1,064	4,280	-	4,485	1,066	5,551	1,301
USSR ^{3/}	7	4,593	13,555	-	14,542	-	15,397	-	16,385	1,843
	15	4,851	14,316	987	15,503	-	15,114	988	16,102	799
	23	5,109	15,077	-	16,084	246	14,830	-	15,818	-
Other	7	350	1,928	958	2,886	-	7,683	989	8,672	5,786
	15	362	1,990	902	2,832	-	7,220	933	8,053	5,161
	23	374	2,051	846	2,837	-	6,558	877	7,435	4,538
World Totals	7	24,038	95,350	22,056	117,406	-	106,362	22,406	128,768	11,362
	15	26,536	104,522	20,554	124,976	-	104,598	20,397	125,595	619
	23	29,032	113,693	18,785	132,478	10,271	103,034	19,173	122,207	-

^{1/} No significant price variable in the production equation.^{2/} No significant price variable in the consumption equation.^{3/} No significant price variable in the inventory equation.

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